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RESEARCH NOTE

Effect of Drying on Physico-chemical Properties of Fig Fruit (*Ficus carica* L.) Variety Dinkar

Ghan Shyam Abrol*, Ranjit Pal, A.K. Pandey and S.K. Sharma

College of Horticulture and Forestry, Rani Lakshmi Bai Central Agricultural University, Jhansi-284003, India

*Corresponding author: ghanshyamabrol@gmail.com

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ABSTRACT

Fig is an underutilized fruit in-spite of having several health benefits. The most simple and practical approach for extending the shelf-life of fig fruit is by drying. For this purpose, the fruits were halved and quarter as per oven and oven dried for 6 hrs @ 60±2°C. The fresh as well as dried fruits were subjected to analysis of various physico-chemical characteristics. The results show that there was a loss of ascorbic acid in dried fruits. It was 5.6 mg/100g in dried fruits whereas in fresh fruits it was 10.52 mg/100g. The dried fruits had a rehydration ratio of 3.13:1. Antioxidant activity was higher in fresh fruits compared to the dried fruits. Textural property (*i.e.* hardness) was almost doubled after drying. Sensory analysis showed that dried fruits obtained better scores over fresh fruits for different characteristics. Drying of figs has been found to be a cost effective and an easy method to reduce the bulk and to increase the shelf-life of fruits.

Keywords: Fig, drying, ascorbic acid, antioxidants, sensory analysis

Ficus carica L. variety Dinkar, an improved variety of Daulatabad, released by MKV, Parbhani (Maharashtra), belongs to family Moraceae. It is found growing as minor fruit in Asian nations particularly Nepal, Somalia, South Egypt, Peninsula and India (Khan *et al*. 2011). It is nutritious and tasty and possesses medicinal values (Joshi *et al.* 2014). Its skin is rich in anthocyanin and polyphenols (Vallego *et al.* 2012; Saklani and Chandra, 2011; Goncalves *et al.* 2010) and thought to possess higher phenolic content than red wine and tea (Saklani and Chandra, 2011). The whole fig is rich source of minerals (sodium, potassium, calcium, magnesium, zinc, copper and phosphorus), vitamins (A, B_1, B_2 and C), dietary fiber, starches, basic amino acids and in addition to phenolic substances (Vallego *et al.* 2012; Naikwadi *et al.* 2010; Xanthopoulos *et al.* 2009; Xanthopoulos *et al.* 2010).

Bundelkhand is a hot and dry region of central India and has great potential of growing horticultural crops particularly anola, ber, fig, guava etc. The dried product is generally thought to be safe and shelf-stable (Solomon *et al.* 2006) but different pretreatments before drying destroy the ascorbic acid content in fruit to a significantly low level (Slavin, 2006; Vinson, 1999; Slatnar *et al.* 2011). Therefore, the present study was focused on standardization of low cost drying techniques for the preparation of dried fig with better retention of vitamins and other physico-chemical characteristics for fig grown in Bundelkhand region.

MATERIALS AND METHODS

Raw material

The fruits were collected from the experimental orchard of Rani Lakshmi Bai Central Agricultural University, Jhansi and all the physico-chemical analysis for fresh and dried figs were carried out in the Horticultural lab.

For preparation of dried figs, the small fruits were cut into two equal halves and large fruits in equal quarters. These were dried in an oven at 65± 2ºC for 6 hrs and packed in air tight container (Fig. 1).

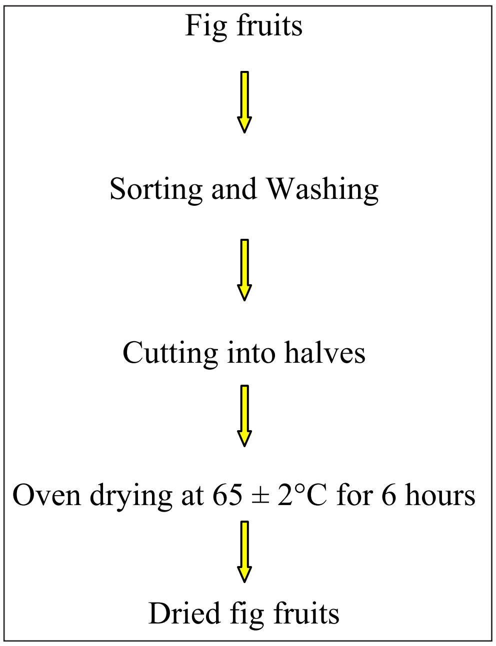

Fig. 1: Unit operation for drying figs

Physico-chemical analysis

Rehydration was carried out in distilled water at 45°C for 5 hours for facilitation of various physico-chemical analysis (Ranganna, 1986). After rehydration period, the excess water was drained out. Rehydration ratio (*Rr*) was expressed as a ratio of water absorbed by the dried sample (*Wr*) to the weight of the dried sample (Wd) (AOAC, 2000).

$$Rr = Wr / Wd$$

TSS of fresh and dried samples (after rehydration) were measured using Erma hand Refractometer and the readings were corrected for temperature variation to 20°C as per International Temperature Correction Table (Horwitz, 1980) and the results were expressed as °Brix. Titratable acidity was estimated by titrating a known volume of the sample against standard 0.1 N NaOH solution by using phenolphthalein as an indicator up to the end point (pink colour). The titratable acidity was expressed as per cent malic acid (AOAC, 2000).

Titratable acidity (%) =

$$\frac{\text{Titre} \times \text{Normality of alkali} \times \text{volume made up} \times \text{equivalent weight of acid}}{\text{Vol./wt. of sample taken} \times \text{volume taken of aliquot} \times 1000}$$

The estimation of reducing and total sugars by titrating against a known quantity of Fehling's A and Fehling's B solution using methylene blue as an indicator (Lane and Eynon, 1923). Reducing sugars were expressed as per cent unit.

Ascorbic acid content of both fresh and dried figs was determined as per standard method using 2, 6- dichlorophenol indophenol dye (Ranganna, 1986) after extracting in 3% m-phosphoric acid and titrating with the dye to an end point of pink colour. Results were expressed as mg per 100 g of sample.

Antioxidant activity (Free radical scavenging activity) was measured as per the method of Brand-Williams *et al.* (1995). DPPH (2, 2-diphenyl-1-picrylhydrazyl) was used as a source of free radical. A quantity of 3.9 mL of 6×10^{-5} mol/L DPPH in methanol was put into a cuvette with 0.1 mL of sample extract and kept for 30 min. in dark and absorbance was measured at 515 nm Methanol was used as blank. The remaining DPPH concentration was calculated using the following equation:

$$\text{Antioxidant activity (\%)} = \frac{Ab_{(B)} - Ab_{(S)}}{Ab_{(B)}} \times 100$$

Where,

$Ab_{(B)}$ = Absorbance of blank

$Ab_{(S)}$ = Absorbance of sample

The textural properties viz. hardness (positive area under the curve) and softness (negative area under the curve) of fresh and dried figs were measured using Texture Analyzer, TAXT2i (Stable 70 Microsystems, UK) using P/ 75 cylindrical probe. Force calibration of the instrument was done prior to start of the experiment to minimize measurement error. The instrument was operated at pre-test speed = 3.073 mm/s, test speed = 2 mm/s, post test speed = 10 mm/s, distance = 30 mm, stain rate = 60%, trigger force = 5 g. force and data acquisition rate of 150 pps. The textural data (force vs. time) was analysed by the instrument software (TEE 32).

Sensory analysis

Sensory analysis was performed using 9 point hedonic scale (Ranganna, 1986). Coded samples were given to the five judges and asked for evaluation as per prescribed proforma.

Statistical analysis

Depending upon the requirements, the statistical analysis of the data was carried out. The data of sensory analysis generated by different experiments in general were analysed and presented as a bar diagram.

RESULTS AND DISCUSSION

Physico-chemical analysis of fresh fig (Table 1) shows that it contains a fair amount of total soluble solids (12.20 ± 0.16°B), moisture content (78.57 ± 0.007%) but medium titratable acidity (0.53 ± 0.002 %MA).

Table 1: Functional properties of fresh figs

Physico-chemical characteristics	Fresh fig*
TSS (°B)	12.20 ± 0.16
Moisture content (%)	78.57 ± 0.007
Titratable Acidity (%MA)	0.53 ± 0.002
Reducing sugars (%)	5.11 ± 0.09
Total sugars (%)	8.28 ± 0.03
Ascorbic acid (mg/100g)	0.02

**Mean ± Standard deviation.*

The higher moisture makes the fruit more susceptible to microbial and physiological damage. Fig fruits also contain a good amount of ascorbic acid (5.6 mg/100g) which is a potent antioxidant in nature and protect from various diseases and disorders.

Fig. 2 shows the effect of oven drying on moisture loss in fig against the drying time. As the initial moisture content is very high so the loss of moisture from 0-3 hrs is very high. As the moisture content decreased, loss in weight is also reduced as compared to the initial weight. After 5 hours, equilibrium point was reached where there was no loss in weight from 5-6 hours. Drying of fruits is a complicated process involving simultaneous, coupled heat and mass transfer phenomena occurring inside the material (Yilbas *et al.* 2003). A number of workers have reported the similar drying effects (Yaldiz *et al.* 2001; Midilli and Kucuk, 2003; Akpinar and Bicer, 2008; Abrol *et al.* 2014).

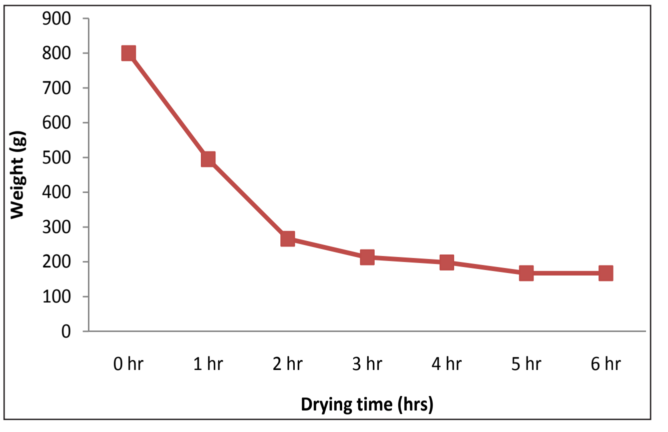

Fig. 2: Oven drying trend observed in fig fruits

Effect of different treatments on physico-chemical properties of dried fig is shown in Table 2. The dried fruits had shown a good rehydration ratio (3.13:1). All the physico-chemical paramters were increased after the drying of fig which would help in increasing its shelf-life. The TSS, titratable acidity, reducing sugars, total sugars and ascorbic acid were found in rehydrated figs as 38.30°B, 1.32%MA, 19.42%, 30.47% and 5.6 mg/100g, respectively. Ascorbic acid, a water-soluble vitamin, is difficult to retain during the dehydration of foods because of its susceptible to heat (Takeoka *et al.* 2001; Dewanto *et al.* 2002). Moreover, ascorbic acid and its oxidation product (dehydro ascorbic acid) has many biological activities in the human body due to its antioxidant properties (Davey *et al.* 2000; Lee and Kader, 2000).

Table 2: Functional properties of dried fig fruits

Physico-chemical characteristics	Dried fig
TSS (°B)	38.30 ± 0.04
Rehydration ratio	3.13:1
Titratable Acidity (%MA)	1.32 ± 0.01
Reducing sugars (%)	19.42 ± 0.06
Total sugars (%)	30.47 ± 0.04
Ascorbic acid (mg/100g)	5.6 ± 0.06

**Mean ± Standard deviation.*

Figure 3 shows the antioxidant/free radical scavenging activity of fresh and dried figs. Fresh fruits showed high antioxidant activity than dried figs. The decrease in antioxidant activity was from 73% to 45% with ascorbic acid content which is decreased after drying due to its sensitivity to heat (Kapasakalidis *et al.* 2006). DPPH is stable free radical with characteristic absorption at 515 nm and antioxidants released from fruits react with DPPH radicals and converts it into 2,2-diphenyl-1-picrylhydrazine. The degree of discolouration in colour indicates scavenging potential of the antioxidant extract, which is due to the hydrogen loss from antioxidants (Abrol *et al.* 2014).

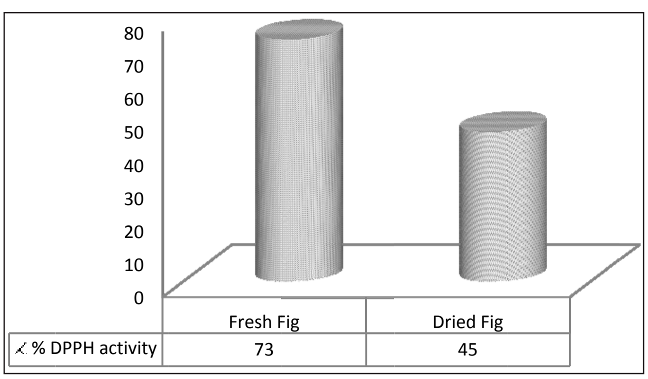

Fig. 3: Antioxidant properties of fresh and dried figs

Hardness or crispiness is related with the amount of loss in water, compactness of fruit and its total constituents. The drying resulted in an increase in hardness (Fig. 4). During drying, there is change by the diffusion of water from outside to the core. Drying almost doubled the hardness of fruit and it is changed from 0.889 kg/ sec to 1.971 kg/sec. Similar effect was reported on fig drying earlier (Ansari *et al.* 2014) and nuggets (Sharma *et al.* 2015). Rahman and Al-farsi (2005) examined the hardness of date flesh and rice-based products as a function of moisture content and also attributed this behaviour to the rubbery-leathery transition. The rubbery-leathery transition was expressed when the force required to compress the sample suddenly increased with a decrease in moisture content.

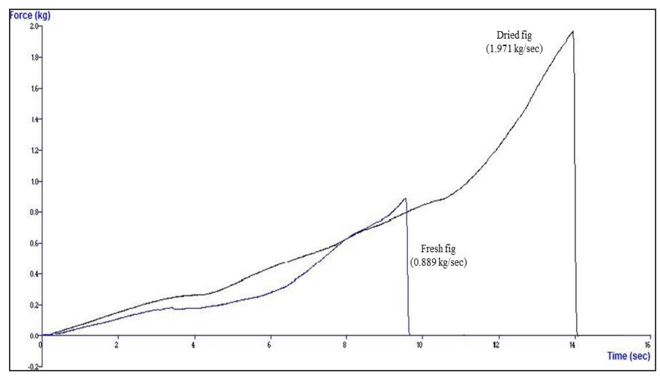

Fig. 4: Textural properties of fresh and dried figs

Sensory analysis conducted by the panel of judges for the fresh and dried figs is described in Fig. 5. Colour, texture, flavour, taste and overall acceptability of dried figs is adjudged as best over fresh figs. The low score in flavour might be due to astringency observed in fresh fruits as it is evident from earlier studies (Abrol *et al.* 2014; Parmar and Kaushal, 1982).

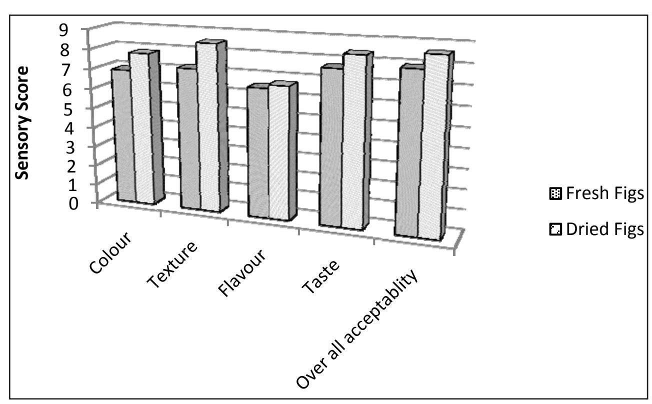

Fig. 5: Sensory analysis of fresh and dried fig fruits

CONCLUSION

The dried fruits have longer shelf-life and nutritional value as compared to fresh fruit. These can be used for table purpose or in the preparation of various culinary items.

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